

R. Whittier's Review of HBWS Comments on the Monitoring Well Installation Work Plan

First, I generally agree with HBWS's comments with the exception of doing an aggressive intrusive LNAPL investigation near the tanks. It has been two and a half years since the release, the chance of finding anything recoverable is low and does not justify the cost that would be required.

Here are my specific comments:

Section 1 – Background, Page 1

First Paragraph

Concur - Perched water is common in the Halawa Valley near area where RHMW11 is proposed. Also, TEC, Inc. found a perched water zone that extended from 85 down to about 130 ft below ground surface (bgs) when drilling RHMW04. A review of the boring logs for RHMW06 & 07 found no mention of perched water.

Section 2 – Project Quality Objections, Page 2

First Paragraph

Do not concur – While it seems the objectives described by the Work Plan are not going to be met by the execution of this Work Plan, an extensive intrusive search for LNAPL is not warranted since none of the current monitoring wells, with the exception of RHMW02; show any indication of LNAPL in the vicinity. Any LNAPL plume large enough to pose a risk to a drinking water source should show evidence in other wells also.

Second Paragraph

Concur - A comprehensive TOC elevation survey of all wells used in the proposed and past groundwater gradient surveys and aquifer tests is needed. What is proposed are standard survey methods. This may not be adequate. When RHMW05 TOC was surveyed, its elevation was referenced to the TOC elevation of OWDB-MW1. The survey was also extended to RHMW01 to tie this survey into one done during the TEC Inc. (2007) investigation. It was found that there was over a 0.3 ft difference between the TOC elevation of RHMW01 relative to OWDF-MW1 when the results of the two surveys were compared (TEC Inc. 2010). This is a distance of about 2,500 ft. Extending the error out to a mile increases it to over 0.6 ft/mi. A common assumed groundwater gradient is about 1 ft/mi. Differences between true and surveyed similar to that just described can insert large errors into the gradient calculations. The proposed approach to assess the risk that the Facility poses to groundwater and drinking water is defining the groundwater flow paths using gradient measurements and modeling. Both of these techniques require accurate groundwater elevation measurements for validation.

Third Paragraph

*Concur - The blue arrow depicting the “regional groundwater flow” is both pervasive and not supported by available evidence. To be “regional groundwater flow” implies the groundwater recharged in the upper elevation migrates along a path depicted by that arrow and discharges to the sea at point described by the orientation of the blue arrow. The assumed regional groundwater flow direction is based upon the model of Rotzoll and El-Kadi (2007) and a generalized conceptual model of Nichols et al. (1996). The model of Rotzoll and El-Kadi is essentially an uncalibrated model since there were TOC elevation inconsistencies in the observation wells used to calibrate the model. Also, there was only one observation well with the Red Hill Ridge used to calibrate the model. Groundwater flow direction can’t be calculated based on a single point. HBWS in bullet 1) give examples of respected reports that state the groundwater flow could be from the Moanalua to the Pearl Harbor Aquifer. Also, the assumed regional groundwater flow direction is actually **not** supported by the hydrogeologic evidence available for the Red Hill area. A review of the water table elevations measured during the oil/water interface measurements taken during 2010 shows no measureable gradient between RHMW03 and RHMW01, and only a shallow gradient if RHMW05 is included in the calculations. The measurements taken during 2010 were reviewed because the downhole pumps were removed during these oil/water interface measurements.*

Section 2 – Project Quality Objections, Page 3

Bullet 4)

Concur – Also, fuel related constituents have also been detected in RHMW04, suggesting groundwater flow from beneath the USTs to the northwest.

Second paragraph after the bullets

Concur - HBWS is correct in the desire for precision measurements to detect and deviation in the bore hole from true vertical. Since the groundwater gradient measurement is the primary approach to characterizing groundwater flow patterns it is imperative that as many sources of error as possible be removed from the equation. This includes removing sources of error by acquiring accurate TOC surveys (described above) and true vertical depth surveys. This is commonly done with the gyroscopic instruments described by HBWS. This enables corrections to be applied to any groundwater level measurements. A gyroscopic True Vertical Depth survey (TEC, Inc. 2001) was done on the monitoring well network for the Hickam POL sites at Wheeler Army Airfield and Kipapa Gulch where the depth to water varied from about 300 ft to 700 ft. The difference between the wireline measured depth to water and the true vertical depth to water varied from 0.08 to 2.92 ft. With groundwater gradients of approximately 1 ft/mi. it is important that a true vertical depth survey done since errors in water level measurements will result in incorrect groundwater gradient calculations.

Section 3 – Monitoring Well Network Design and Rationale, Page 3

First Paragraph

Concur - Although more applicable to the Task 6&7 SOW/WP, the lack of any comprehensive assessment methodology for LNAPL migration in the vadose zone and on the water table is a serious shortcoming in the proposed approach.

Second Paragraph

This statement is not totally accurate - RHMW08 is in the vicinity of the USTs and also correctly located to intercept LNAPL migration in the vadose zone (due to the dip of the lava beds) and on the water table (due to the local gradient induced by pumping at the Red Hill Shaft).

Section 3 – Monitoring Well Network Design and Rationale, Page 4

Bullet 1)

Concur - It is true that the depth and width of the valley fill depicted in Figure 3 is inaccurate is significantly greater than what one would expect by reviewing available documentation.

The attached Figure A includes the trace of the cross-section overlaid on the Oahu geology as defined by the USGS (Sherrod et al., 2007). The table below compares that actual valley fill widths compared to that implied by Figure 3.

Valley	Sherrod et al Width	Figure 3 Width	Percent difference	Comments
	(ft)	(ft)	(Figure 3-Sherrod)/Sherrod	
Moanalua	950	>1,950	>105%	Cross-section is incomplete
South Halawa	900	1,550	72%	
North Halawa	1020	>>1,300	>>27%	Cross-section is incomplete

Shown on the map provided are the location of the Facility monitoring wells including RHMW07 and HDMW2253-03. Figure 3 implies that the valley alluvium extends down to just above the screen of RHMW07 to just above the water table. Attached is page 1 (Figure B) of the RHMW07 bore log. The alluvium is only present to about 27 ft bgs. This oversight is significant since projecting the valley fill low in the borehole of RHMW07 results in an estimated valley fill depth that is not supported by the bore hole data.

The depth of valley fill is not consistent with other available data. Figure C shows a projection of the USTs (northeast to southwest), profile of South Halawa Stream, the water table, and the stratigraphy of HDMW2253-03. This figure shows the saprolite at HDMW2253-03 only

extending 33 ft below sea level (or about 53 ft into the water table). HDMW2253-03 is located about 780 ft northeast of the Figure 3 transect line. If it were projected southwest onto the transect line it would be located about 150 ft to left of the lower “Branch of South Halawa Stream” vertical label. At this point the depth of the saprolite would be about -48 ft msl. Thus it seems that Figure 3 significantly overestimates the width and depth of the valley fill based on available data.

Bullet 3)

Concur - Based on the geology of Sherrod et al. (2007), (see Figure A) the proposed location of RHMW11 is, at best, located in an area of thin alluvium. The depiction in Figure 3 appears to be inaccurate.

Section 3 – Monitoring Well Network Design and Rationale, Page 4

Bullet 4)

It is unclear what other “units” HBWS is referring to.

Bullet 5)

Concur - The depiction of the Halawa Shaft as a vertical well terminating in the alluvium is inaccurate. It has an inclined access tunnel bored into the northwest wall of North Halawa Valley. The inclined tunnel provides access to a horizontal infiltration gallery along the water table in the basalt. The actual location of the Halawa Shaft would be to the very left edge of Figure 3 and there would be no alluvium there. Plate 1 from Izuka (1992) (previously provided) is a more accurate depiction of the Halawa Shaft and the North Halawa Valley fill.

Bullet 6)

Concur - To confirm that the valley fill is protective of the Halawa Shaft would require more than one borehole midway across Halawa Valley (i.e. RHMW11). To properly assess the degree to which the valley fill is protective of the Halawa Shaft would require a series of geotechnical borings to define the depth and geometry of the valley fill.

First paragraph after the bullets

The HBWS is correct, there is no geology shown on Figure 4.

Third Paragraph

Concur - Bridging caused by bentonite chips when fed from the surface likely will get hung up in the borehole resulting in bridging. SOP I-C-1 Monitoring Well Installation and Abandonment cited by the Work Plan calls for a pure sodium bentonite seal that extends 3 to 5 ft above the

filter pack then a bentonite/cement grout to the surface. There is a conflict between the Work Plan Figure 5 and SOP 1-C-1.

Section 3 – Monitoring Well Network Design and Rationale, Page 7

Second Paragraph

Concur - It is important to log the structures that affect groundwater flow and not just the petrology of a borehole. The Work Plan should be modified to explicitly state this.

Third Paragraph

Concur - It does seem inconsistent with the purpose of rock coring to devote most of the description to soil sampling. Without detailed logging of macro-features that affect groundwater flow, the whole point of rock coring is minimized.

REFERENCES

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